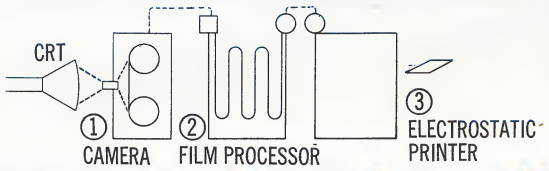
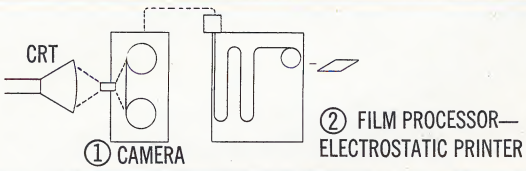
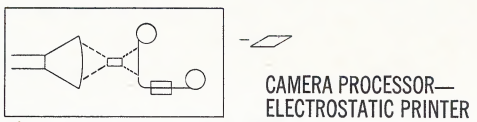
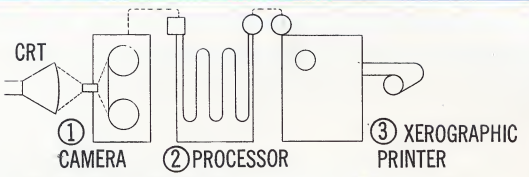
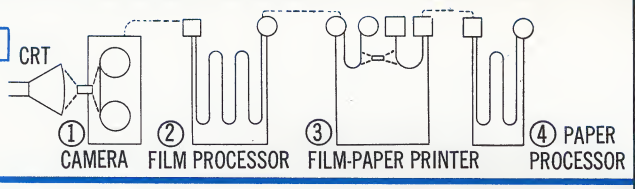
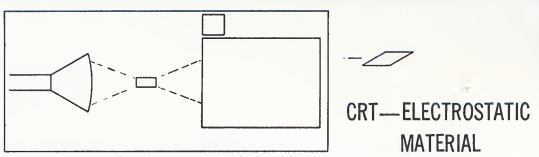
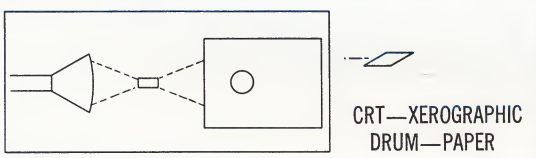
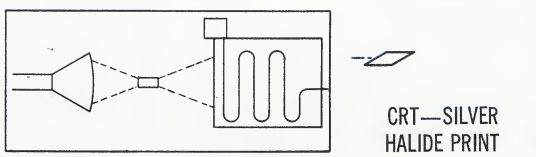
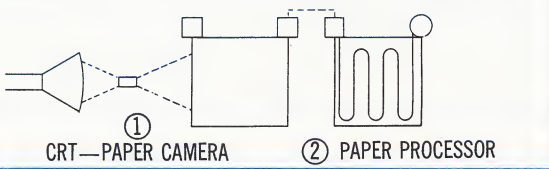
PHOTOMECHANISMS' COMPARISON CHART

	EQUIPMENT USAGE	METHOD	CRT REC. RATE	ACCESS TIME TO HARD COPY	HARD RESOLUTION
1		CRT to FILM TO ELECTROFAX ① CRT—FILM, ON-LINE ② FILM PROCESSED ③ FILM—ELECTROFAX PRINTER	VERY HIGH, MAY BE IN EXCESS OF 5000 7½ IN LINES PER SEC.	LONG—SUM OF CAMERA TIME PLUS FILM PROCESSING, PLUS PRINTING	5-7
2		CRT TO FILM TO ELECTROFAX ① CRT—FILM, ON-LINE ② FILM PROCESSOR TO COUPLED ELECTROFAX PRINTER	VERY HIGH, AS ABOVE	MODERATE—SUM OF CAMERA TIME, PLUS 2-3 MIN.	5-7
3		CRT TO FILM TO ELECTROFAX ① CRT—FILM—PROCESSOR—EFAX PRINTER, ALL ON LINE	MODERATELY HIGH, 200-400 LINES/SEC.	SHORT—26 SEC.	5-7
4		CRT TO FILM TO XEROGRAPHY ① CRT—FILM, ON-LINE ② FILM PROCESSED ③ FILM—XEROGRAPHIC PRINTER	VERY HIGH AS IN LINE 1	LONG—SUM OF CAMERA TIME, PLUS PROCESSING, PLUS PRINTING	10
5		CRT TO FILM TO SILVER HALIDE PAPER ① CRT—FILM, ON LINE ② FILM PROCESSED ③ FILM—PAPER PRINTER ④ PAPER PROCESSED	VERY HIGH	VERY LONG—SUM OF CAMERA, PROCESSOR, PRINTER, PROCESSOR TIMES	25
6		CRT TO ELECTROFAX ON-LINE	LOW 7-7½" LINES/SEC.	SHORT—3 SEC.—LINE AT A TIME	5-7
7		CRT TO XEROGRAPHY ON-LINE	LOW 14 7½" LINES/SEC.	SHORT—3 SEC.—LINE AT A TIME	10
8		CRT TO SILVER HALIDE ON-LINE	MODERATE—IN EXCESS OF 100 7½" LINES/SEC.	SHORT—35 SEC. FOR COMPLETE PAGE	25
9		CRT TO SILVER HALIDE ① CRT—PAPER ② PAPER PROCESSED OFF-LINE	MODERATE—IN EXCESS OF 100 7½" LINES/SEC.	LONG—SUM OF CAMERA AND PROCESSOR TIME	25

NOTES: 1. This comparison presents as fairly as possible, the comparative characteristics of various hard copy systems.

2. Lines 2 and 8 present characteristics of equipment in development at Photomechanisms. Line 3 presents DATASTAT equipment delivered in two different mo by Photomechanisms.

3. Hard copy resolution is expressed in line pairs/mm.

T OF PHOTOGRAPHIC HARD COPY SYSTEMS

D COPY LUTION	HARD COPY RATE	EQUIPMENT COST	HARD COPY COST (MATERIALS)	COMMENTS
/MM.	LOW — 3-4/MIN.	PROCESSOR, PLUS PRINTER ≅ $15K (LESS CAMERA)	≅ $.04 FOR 8½"x11"	THIS IS A LOW PRODUCTION SYSTEM, HIGH IN LABOR COST; POOR ACCESS TIME; ORIGINAL EQUIPMENT COST REASONABLY LOW. CAN MAKE 18x24 IN. PRINTS
/MM.	HIGH — 30 8½"x11" PER MIN.	≅ $20K (LESS CAMERA)	≅ $.04	A PRACTICAL SYSTEM FOR HIGH VOLUME PRODUCTION; REASONABLY SHORT ACCESS TIME; LABOR COST LOW; EQUIPMENT COST MODERATE
/MM.	MODERATE — 12 8½"x11" PER MIN.	≅ $25K (LESS CRT)	< $.05	A GOOD SYSTEM FOR SHORT ACCESS TIME. VOLUME IS RELATIVELY LOW; EQUIPMENT COST IS MODERATELY HIGH; LABOR COST IS LOW
/MM.	HIGH — GREATER THAN 20 FT./MIN.	PROCESSOR, PLUS PRINTER ≅ $80K (LESS CAMERA)	≅ $.03 IN HIGH VOLUME USE	A MUCH USED SYSTEM. RATE IS GOOD; ACCESS TIME IS LONG. SYSTEM COST IS HIGH. LABOR COST IS MODERATELY HIGH
/MM.	HIGH — CAN BE 25 FT./MIN.	PROCESSOR, PLUS PRINTER, PLUS PAPER PROCESSOR ≅ $30K (LESS CAMERA)	> $.10	CAPABLE OF HIGH SPEED AND VERY HIGH QUALITY. NUMBER OF STEPS INVOLVED INCREASES LABOR COSTS, AND ACCESS TIME. MATERIAL COSTS ARE QUITE HIGH
/MM.	MODERATE — 9 8½"x11" PER MIN.	≅ $14K WITH CRT	$.03 TO $.04	THE RELATIVELY LOW RECORDING RATE IS LIMITED BY THE PAPER SENSITIVITY. LINE-BY-LINE ACCESS TIME IS SHORT EQUIPMENT COST, INCLUDING A SHAPED BEAM CRT, IS MODERATELY LOW
/MM.	MODERATE — 18 8½"x11" PER MIN.	≅ $40K WITH CRT	> $.02	HIGHER RECORDING RATE THAN ABOVE, BUT LIMITED BY DRUM SENSITIVITY. LINE-BY-LINE ACCESS TIME IS SHORT. AS ABOVE, EQUIPMENT COST IS QUITE HIGH
/MM.	LOW — 6 8½"x11" PER MIN.	$8-10K (LESS CRT)	≅ $.10	MODERATE RECORDING RATE; LOW HARD COPY RATE; QUALITY EXCELLENT; EQUIPMENT COST LOW; COPY COST QUITE HIGH
/MM.	HIGH — 60 8½"x11" PAGES/MIN.	≅ $15K (LESS CRT)	≅ $.10	RELATIVELY HIGH RECORDING RATE; HIGH HARD COPY RATE; EXCELLENT QUALITY; ACCESS TIME TO HARD COPY IS LONG; COPY COST QUITE HIGH

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PHOTOMECHANISMS Incorporated

Presents...

NEW TECHNIQUES FOR HARD COPY GENERATION FROM CRT DISPLAYS

THE VALUE OF CRT DISPLAYS

During the past decade improvements in cathode ray tube technology have matched the increased capabilities of digital computers. The CRT today is capable of extremely high resolution and is acknowledged to be the fastest, most flexible means of displaying the output of a high speed computer.

With the expansion of computer capabilities and parallel advances in programming, many types of information are being generated which can be displayed (alone, or in combination) on a CRT. This information can be alphanumeric plus symbols, graphic information (patterns, drawings, vectors, etc.) or background material such as maps and photographs. In addition, TV presentations of various types are traditionally best displayed on a CRT.

At the present time, CRTs are less popular than typewriters, electromechanical plotters, line printers, etc. for computer output display. This is due, in part, to the limited number of systems available for the economical production of permanent hard copy from the CRT display, as well as to unfamiliarity with the means of utilizing CRT displays. Where CRTs are now being used as computer display devices, access time to hard copy is excessively long, equipment cost is high, quality may be poor, or one of several other factors may preclude an entirely satisfactory system.

THE NATURE OF HARD COPY REQUIREMENTS

This lack of satisfactory hard copy capability is at present a deterrent to full exploitation of the inherent advantages of the CRT as a display device. In our opinion, depending on the specific system requirements, a practical CRT hard copy system must possess one or more of the following capabilities:

(1) **A recording rate as near the maximum display rate as possible.** If a film intermediate is used, random input camera command pulse rates approaching 100/second will permit recording of 5000 lines of data/second. The film intermediate then requires processing and a system must be provided for printing hard copy from the processed film. The processor and printer may or may not be coupled on line with each other.

(2) **An integrating ability to permit recording of extremely high resolution displays** on CRTs designed for, and properly utilized for, this purpose. Processing of the record may, or may not be on-line with the CRT recording station, and may be on one of several types of materials.

(3) **Production of high quality line-type or continuous tone copy direct from the CRT to paper hard copy.** Processing may or may not be on-line with the CRT recording station.

(4) **Recording of short burst, high rate CRT displays with minimum access time to hard copy.** Requires a film internegative and on-line hard copy printing.

PRACTICAL HARD COPY SYSTEMS

Today, a number of photographic materials and methods appear to be of practical value for use in producing hard copy from CRT displays. The variety of these materials, principally silver halide, (both film and paper), Electrofax and Xerography, combined with various possible system configurations presents an almost bewildering array of potentially useful systems.

The chart is a compilation of various CRT recording and hard copy systems grouped for comparative purposes. Note that the number of systems, actual and potential, is somewhat expanded by the various possible on-and-off line combinations of system elements.

It is evident that no one system is the answer to all possible requirements for hard copy generation. The final choice of the best system depends on at least the following factors:

1. Rate of display of data on the CRT
2. Volume of data per day
3. Type of data to be reproduced
4. Required access time to hard copy

Added to these are the various economic factors:

1. Cost per copy
2. Cost of the equipment (amortized cost/copy)
3. Cost of maintenance (reliability)

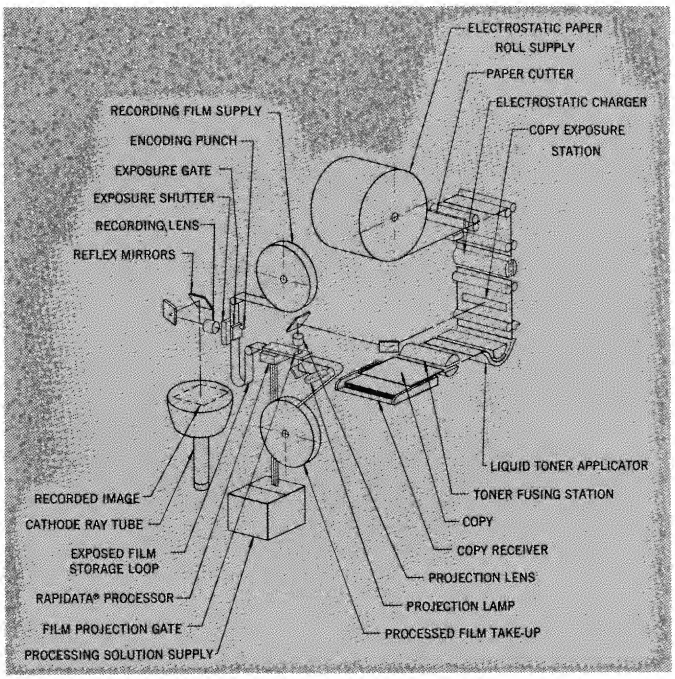


FIGURE 1—Schematic View of Components of a DATASTAT Hard Copy System.

PHOTOMECHANISMS' HARD COPY EQUIPMENT

Recognizing the growing need for hard copy from CRT displays, Photomechanisms has developed and is delivering systems for

PHOTOMECHANISMS Incorporated
15 Stepar Place, Huntington Station, New York 11746
Telephone: (516) HA 3-4411

this purpose. The equipments now in use and those in development should satisfy many current recording requirements. These requirements may be classified as follows:

Moderate Volume—Rapid Access to Hard Copy

Two types of equipment are available, our DATASTAT and DATASTAT II. Each uses a rapidly processed silver halide internegative printed onto Electrofax papers with an access time of 26 seconds to 8½ x 11 copy. Black line copy on white background is obtained from a bright character, or other display, at the rate of 12 per minute.

Low Volume—Rapid Access to Hard Copy

Again, two types of equipment are available, our DATACOPY, Types A and B, with page-by-page exposures on silver halide paper. Both types provide very high quality copy from either alpha numeric or continuous tone TV displays. Access time varies from 35 to 60 seconds, rate is 6 8½ x 11 pages per minute.

High Volume—Moderate Access Time to Hard Copy

Accepting 16 or 35 mm film from any data recording camera, Photomechanisms' DATAFLO equipment processes the film and on-line prints the processed images onto the highest quality electrostatic hard copy. Access time is 5 minutes and the rate is 30 8½ x 11 copies per minute.

THE DATASTAT SYSTEM

The basic characteristics of DATASTAT are listed on line 3 of the chart. The DATASTAT principle is unique and exploits close coupled CRT recording, rapid film processing and electrostatic hard copy printing.

Figure I depicts the normal relationship between components of the DATASTAT system.

In the DATASTAT system, the following sequence is initiated simultaneously with a data frame display on the CRT monitor:

(1) A shutter is opened and closed on pulse command by the user. The data frame is exposed on 35 mm film through a high quality lens.

(2) Successive frames are recorded on command—at rates up to 4 per second, for a maximum of 25 frames, or may be recorded at as low a rate as desired. The exposed film is rapidly advanced into a loop between the film gate and the processor.

(3) An on-line processor (our RAPIDATA® Photoprocessor) develops and stabilizes the data image in about 8 seconds.

(4) The processed image is flow-printed by a projection optical system onto charged electrostatic paper, liquid-toned, and dried.

Figures 2 and 3 show the configuration of this equipment.

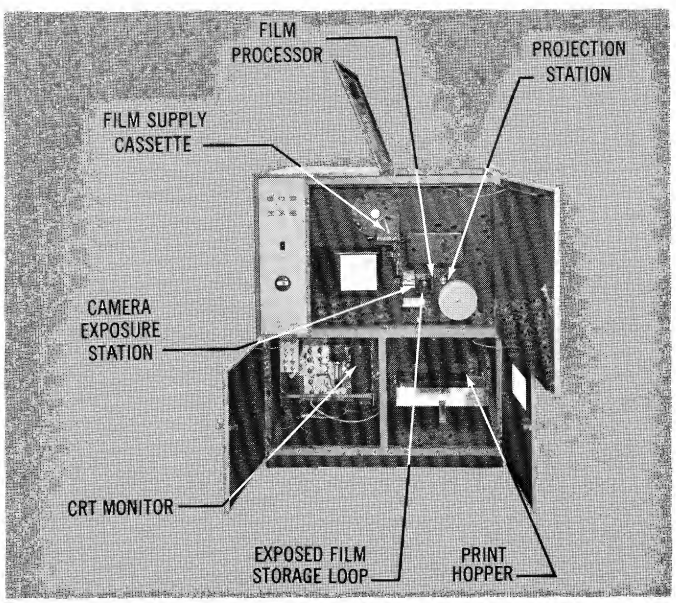


FIGURE 2—View of the front of the DATASTAT unit showing the film path and optical systems.

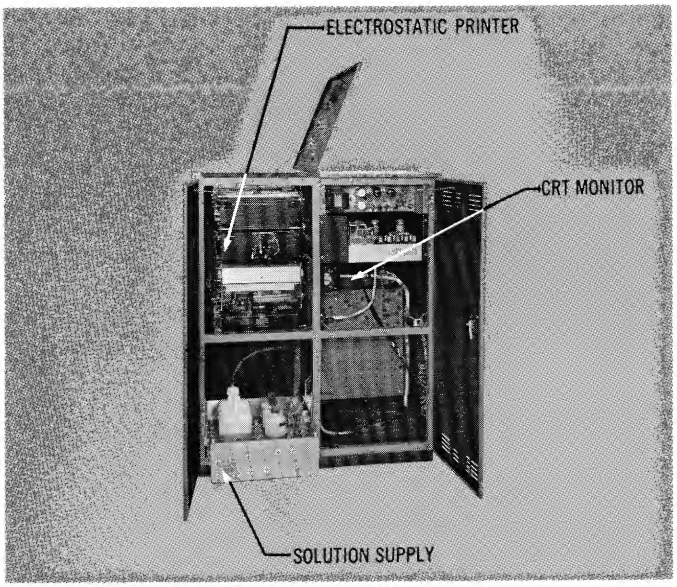


FIGURE 3—Rear view showing the CRT assembly, electrostatic printer and solution supply for the film processor.

DATASTAT II

In function DATASTAT and DATASTAT II are identical. The latter, shown in Figure 4, has been repackaged to fit into a standard 24 inch electronic rack and will accommodate up to a 7 in. diameter CRT mounted within the package.

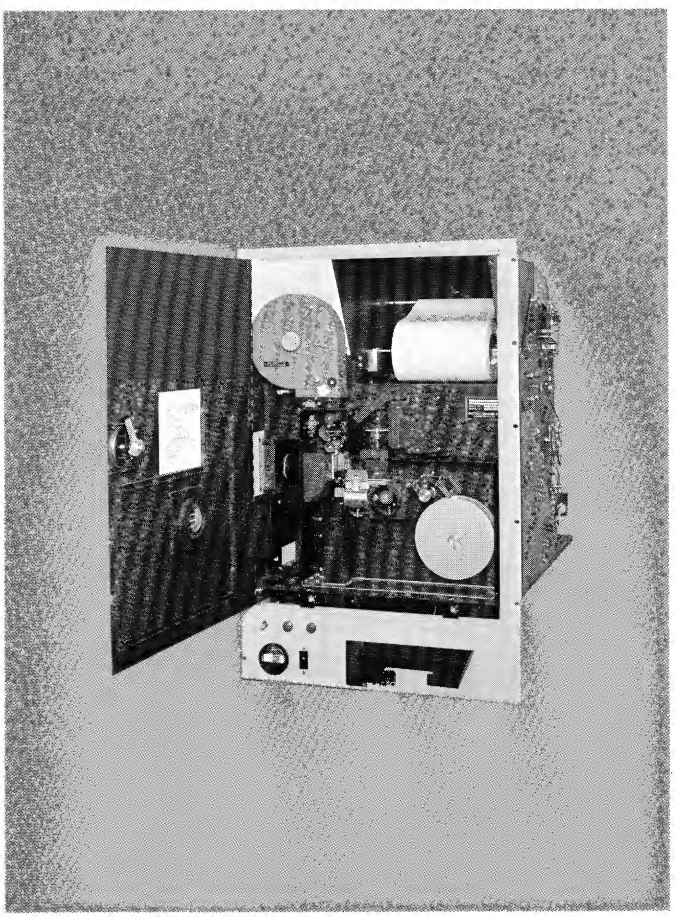


FIGURE 4—Interior of DATASTAT II showing film supply, film gate, processor, printing source and roll of electrostatic paper supply. External measurements are only 24″ x 36¾″ x 29½″.

The Film Processing in DATASTAT

Figure 5 shows the RAPIDATA® Photoprocessor unit—an important part of the DATASTAT system. In it the exposed film is processed automatically in the short space between the exposure gate and the projection station.

Electrostatic Printing in DATASTAT

The hard copy printing system in the DATASTATS is designed for reliable production of line or continuous tone copy using liquid toner.

Figure 6 shows a typical, unitized printer subassembly utilizing roll paper, cut-off knife, corona charging, and replenishment-type liquid toning of the copy image.

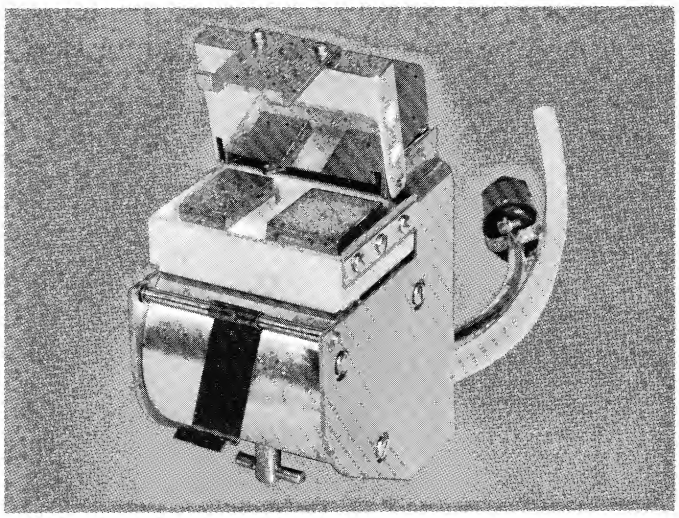


FIGURE 5—The compact, temperature controlled RAPIDATA® Photoprocessor which processes film in 8 seconds. Less than 3 inches long, it develops and stabilizes the 35 mm film in DATASTAT by applying solutions to the emulsion side only.

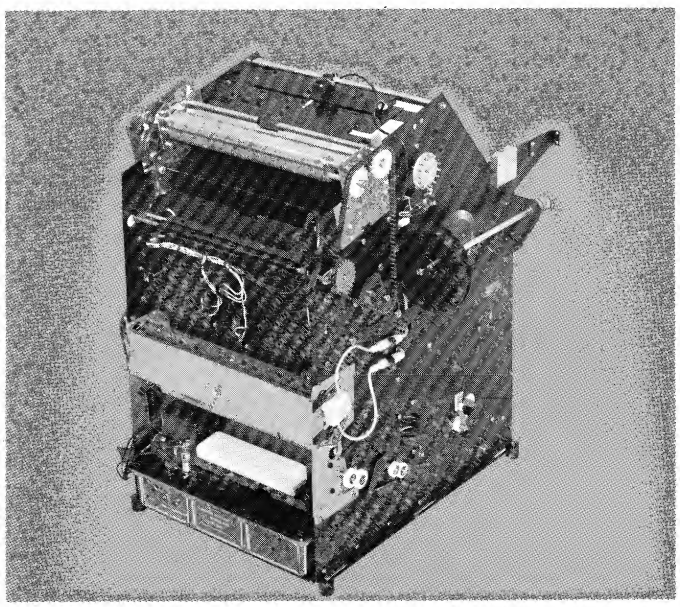


FIGURE 6—Coupled to the drive system in a DATASTAT this highly reliable printer unit converts projected optical data to hard copy in less than 15 seconds.

The DATASTAT's Advantages

The DATASTAT system offers a unique solution for applications requiring rapid access to hard copy, with moderate average volume. Its advantages may be summarized as follows:

(1) Recording Sensitivity
The high speed of the CRT recording film used permits recording of data at rates higher than those possible with other sizes and types of materials.

(2) Recording Rate
Information can be recorded in high speed bursts, accumulated in a loop and printed out at the average rate of the system.

(3) Access Time
Processed data is ready for projection in less than 10 seconds from display on the CRT. Hard copy is available in 26 seconds.

(4) Permanent Record
The internegative makes possible a permanent microfilm record of each print.

SILVER HALIDE HARD COPY

For some purposes, and in particular where initial equipment cost is a prime factor, direct CRT recording on silver halide paper offers an advantage. Quality can be excellent, with very high speed materials available when needed.

Image Sense

Two types of silver halide printing papers are now available for either direct positive or direct negative prints of a CRT display. Direct negative prints are used, for example, to record character or line displays where it is acceptable for the bright line characters to be printed as black lines on a white background.

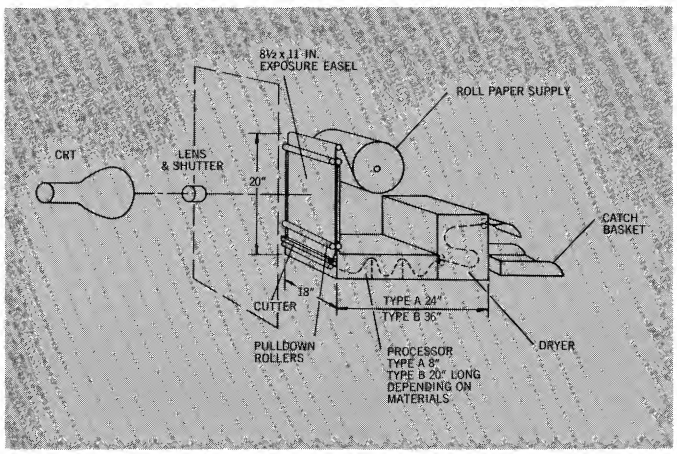


FIGURE 7—A schematic of Types A and B of DATACOPY equipment for production of either negative or positive copy on silver halide materials.

Direct positive prints are of value when it is desired to retain the light and dark relationship normally observed on the CRT, as for example, with a radar display.

Equipment Types

Two types of hard copy printers are now being offered. Each utilizes specially developed, high energy chemistry and temperature controlled, low maintenance, solution applicators.

TYPE A For direct negative copies only. Type A equipment offers 30 to 40 seconds access time for completely dry and flat hard copy. Only two, long-life, processing liquids are needed.

TYPE B Used for either negative or positive copies, this type has an access time of 60 seconds. Three processing solutions are utilized.

These equipments are described on line 8 of the chart.

Equipment Functions

Paper is pulled from a supply roll in a continuous strip through the exposure station. At the completion of the exposure a command re-cycles the unit causing the exposed paper to be pulled through the exposure area, until a new portion of paper is in place, ready for exposure.

The exposed portion is cut off and fed down into the series of either two or three processing applicators where processing is rapidly completed automatically. From the processor, the print is fed into a warm-air, open weave, belt-dryer. Finished prints emerge into a catch tray.

Exposure

The paper emulsions available are of sufficiently high speed to permit direct optical recording of CRT displays where the CRT brightness is relatively high and the writing rates are moderate, and with magnification less than unity. Some retracing of the display may be required for unity magnification and higher.

Paper Transport

The paper is advanced at a rate determined by the processing rate. At an average transport rate of 1.2 in./second, exposures can be made every 10 seconds, and 6 prints/minute will be delivered.

The paper is transported through the system by pinch roller pairs. A cutter blade is actuated when the leading edge of the unexposed paper reaches the output edge of the exposure area. The exposed, separate, cut sheets are automatically transported through the solution applicators and dryer sections.

Access Time

All processing is completed in 10 seconds in Type A and 24 seconds in Type B, the latter being used for either negative or reversal processing. Another 20-30 seconds is needed for complete drying, making the access time for Type A 30-40 seconds, and 60 seconds for Type B. The final high quality copy is dry and permanent.

Processor Units

Trough-type, immersion processing modules with automatic solution feed and level control are incorporated in each equipment. Processing solutions are supplied in convenient kits.

Dryer

A compact dryer of high efficiency provides hard copy for immediate use.

Optical Interface

Both Type A and B hard copy generators are normally supplied without a lens, or housing, for incorporation into the customer's system. We can also supply either type with a lens and housing, or with housing only.

Dimensions

The Type A and B hard copy generators are each self contained and require only a power cord connection. The sizes are as follows:

Type A—20 in. high x 18 in. deep x 24 in. long
Type B—20 in. high x 18 in. deep x 36 in. long

HIGH VOLUME HARD COPY

Photomechanisms now has in development a system called DATAFLO which fills the requirement for an integrated system to make hard copy from large volumes of 16 or 35 mm film exposed to a computer driven CRT. The DATAFLO equipment will produce 8½ x 11 paper prints at relatively high rates.

The system is designed to accept cassettes or magazines from most standard recording cameras. It is entirely self-threading and the operations of film processing, projection and printing, and hard copy production, are all close-coupled on-line with each other.

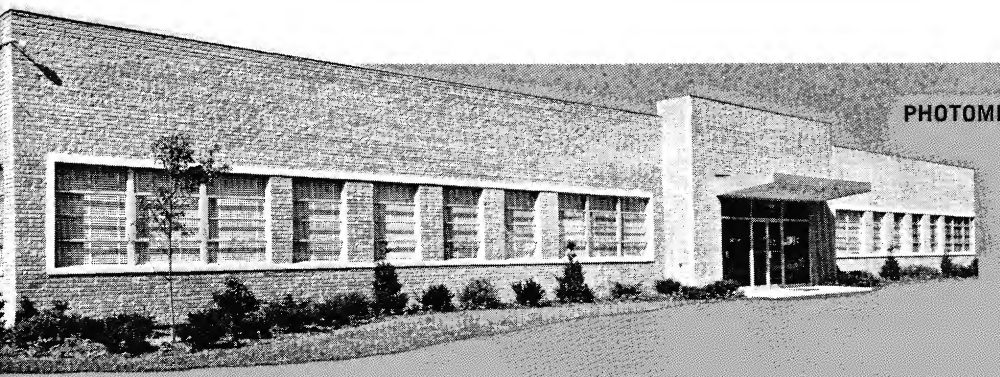
Final hard copy will be of the highest quality electrostatic type with print production at the rate of 30 per minute. This system is described on line 2 of accompanying chart.

APPLICATION ENGINEERING

We at Photomechanisms realize that the field of photographic computer input-output data is in its early stages. We have developed equipment for hard copy generation and have described it here, as it exists, or as it is being planned.

The services of our Research, Development and Engineering Staffs are available to assist you in the solution of your specific problems. Such a solution may require only a modification of present equipment.

Please feel free to contact us on any of your photographic data recording, processing and utilization problems. Your particular problem will receive our prompt attention and a suggested solution based on some of the most varied and extensive experience in this specialized field.



PHOTOMECHANISMS SPECIALIZES IN:

- transient data to hard copy systems
- high performance optical systems
- electro-mechanical-optical devices
- real time camera-processor-projectors
- special purpose data recording cameras
- rapid access and simplified photo processors

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PHOTOMECHANISMS Incorporated

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15 Stepar Place, Huntington Station, L. I., New York

HERE'S THE LATEST.....

on PHOTOGRAPHIC HARD COPY SYSTEMS.....

Like many engineers, you've probably considered using photography to deal with the increasing flow of transient data being generated by computer outputs, telemetry, etc.

The enclosed data sheet and chart are designed to simplify the often confusing choice of techniques and hardware available for the photographic capturing and processing of CRT-displayed data.

Whatever your specific requirement for hard copy, you'll find described here a system to meet it or a technique that can readily be adapted to your application.

We'll be happy to discuss the solution to your transient data problem in more detail and show you just how the available techniques can best be combined to solve it. Just return the enclosed card or call us collect and we'll take it from there.

Incidentally, if you're planning to attend the SID National Symposium in New York, September 29 and 30, you can see an operating hard copy system. We'll be displaying our DATASTAT II – a particularly compact and economical system – and will be glad to demonstrate it for you.

Sincerely yours,

PHOTOMECHANISMS, Inc.

Carl J. Brasser

Carl J. Brasser, Vice President
Product Marketing & Development

CJB:ah

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My application consists of: _____

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☐ Put me on the mailing list for "Hard Copy" design notes.

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